REMARKS

Claims 1-20 are pending.

The election of claims 1-8, 19 and 20 for prosecution is affirmed.

Claims 9-18 stand withdrawn.

In this amendment, claim 1 has been amended and claim 20 cancelled.

Claims 1-4, 6 and 8 are rejected as being anticipated by Catallo, et al., U.S. 6,180,845.

Claim 1, from which claims 2-4, 6 and 8 depend, has been amended to better define the invention.

The object of the present invention is to produce an upgraded biomass which is easy to handle and has a heating value adequate as an alternative fuel to heavy oil or coal. In order to achieve this object, claim 1 of the present application includes the following characteristic features:

(1) an upgrading step for performing upgrading treatment of a cellulose based biomass with an oxygen/carbon atomic ratio of at least 0.5, in presence of water and under a pressure of at least saturated water vapor pressure,

(2) and reducing said oxygen/carbon atomic ratio of said biomass from 0.216 to 0.38,

(3) a separation step for separating an upgraded reactant obtained from said upgrading step into a solid component and a liquid component, and

(4) recovering said solid component which is an upgraded biomass with said oxygen/carbon atomic ratio of 0.216 to 0.38 whose recovered weight is at least 40 % of the weight of said cellulose based biomass.

In the method of upgrading a biomass according to the present application, the oxygen content of cellulose based biomass raw materials is reduced, and the heating value as a fuel is increased.

The characteristic of amended Claim 1 is the condition of upgraded reaction which is in presence of water and under a pressure of at least saturated water vapor pressure. In particular, the mild condition within the upgrading process of the present invention is selected so as to achieve an upgraded reactant with an oxygen/carbon atomic ratio of 0.216 to 0.38.

Basically, in the case of charcoal, since the wood is baked at 400 to 1000° C and undergoes thermal decomposition at a high temperature, the product has an oxygen content of almost 0. Compared to this, in the present invention, upgrading treatment is performed in the presence of water at a lower temperature and a higher pressure, and a mild thermal decomposition process which partially deoxygenates (partially dehydrates) the raw material and produces the oxygen/carbon atomic ratio of 0.216 to 0.38. Taking into consideration the energy efficiency during the upgrading process, the lower limit for the oxygen/carbon atomic ratio is approximately 0.216 (See Specification, page 14, lines 18 to 25; page 27, Example 16).

In addition, as shown above in the characteristic features (3) and (4), the characteristic of the present invention is to include a separation process. This separation process may include not only the separation of the solid component from the liquid component, but where necessary also a drying treatment in those cases in which the water content of the solid component is high (Specification, page 8, lines 5 to 9). Namely, the upgraded biomass of the invention recited in Claim 1 is dewatered and, if necessary, dried to produce a solid component. By including above separating process, the present invention can obtain a dewatered solid component as upgraded biomass at high recovery rate which is at least 40 % of the weight of the cellulose based biomass (Specification, page 15, lines 1 to 4). It is apparent in the Examples of the present application; the recovery ratio of Example 1 is 45.1% (raw materials is 350g, solid component is 158g), the recovery ratio of Example 6 is 47.4 % (raw materials is 470g, solid component is 223g), and the recovery ratio of Example 10 is 42 % (raw materials is 1000g, solid component is 420g).

In addition, in the present invention, since the solid component (upgraded biomass) obtained in the separation process following the upgrading treatment has a heating value per dried weight unit of at least 25.1 MJ/kg (6,000 kcal/kg), a fuel having a superior quality can be stably produced with a high heating value (Specification, page 3, lines 12 to 16). In addition, crushing of the solid component of the present invention (upgraded biomass) can be simple, and can be produced which displays good affinity for water (Specification, page 15, lines 10 to 12).

On the other hand, the method of Catallo et al. (US 6,180,845) for transforming biomass to petroleum-like hydrocarbon mixtures is conduced in severe conditions. Namely, the reaction

process is conduced in supercritical or near-critical reaction conditions, essentially free of any strong oxidants. In particular, the method of Catallo needs to react in the anoxic condition and remove any strong oxidants from the circumstances. In addition, Catallo discloses use of reducing agents (e.g. H_2 gas and $Na_2H_2BO_4$ powder) (Column 2, lines 18 to 22; Column 3, lines 42 to 45). Namely, Catallo aggressively removes the oxygen content from raw materials.

In addition, Catallo discloses that presence of oxygen content is not reasonably feasible because some carbon is lost as CO_2 or CO (Column 4, lines 21 to 22). Also, Catallo discloses that the upgraded biomass obtained by its method is the light (namely, compounds with a molecular weight under 276; Column 5, line 1) liquid upgraded biomass (volatile and semivolatile hydrocarbon) whose yields are on the order of 60% or more (Column 5, lines 38 to 44). In addition, a small amount of particulate residues obtained by the method of Catallo are soot or carbonized residues (Column 5, lines 66 to 67). Thus, oxygen content of their particulate residues may be small.

Compared to Catallo, the method of the invention recited in Claim 1 is not to aggressively remove the oxygen content but to mildly partially deoxygenate from the cellulose based biomass raw materials. Thus, unlike Catallo, the present invention does not need the anoxic condition which is free of any strong oxidants. In addition, the present invention does not need to use the strong reducing agents. Therefore, the present invention is quite different from Catallo in the reactive condition. Moreover, although the oxygen/carbon atomic ratio of the solid component of the present invention (upgraded biomass) is controlled from 0.216 to 0.38, Catallo does not mention and suggest controlling the ratio within the above range. In addition, although phenol is shown as one of the reaction products of Catallo, the oxygen/carbon atomic ratio of phenol is 0.167 which is not included within the range of the present invention as set forth in claim 1.

In addition, the dewatered solid component can be obtained at a high recovery ratio by the method of the present invention. In contrast, the light liquid upgraded biomass (volatile and semivolatile hydrocarbon) whose yield is on the order of 60% or more is obtained by the method of Catallo. Therefore, the difference between the method of the present invention and Catallo is apparent.

Also, while Catallo uses metals such as iron or nickel in order to soften (Column 3, lines 41 to 42), the present invention does not use metals.

Therefore, since there is no mention or suggestion of the object, technical features, and the advantageous effects of Claim 1 of the present application, in Catallo, Claim 1 has novelty and has an inventive step over Catallo. Since Claim 1 has novelty and an inventive step over Catallo, the claim should be allowable. Claims 2-4, 6 and 8, which directly or indirectly depend from Claim 1, recite further features of the invention, have novelty and an inventive step over Catallo, and also should be allowable.

Claim 7 is rejected as being unpatentable over Catallo. Claim 2 depends from claim 6 which, in turn, depends from claim 1. It recites the further feature of the heating value on combustion is at least 27 MJ/kg.

As shown above, the method of Claim 1 of the present application for upgrading a biomass is markedly different from the method of Catallo. Therefore, the upgraded reactant of Claim 7 of the present invention is also different from the products of Catallo. Catallo does not disclose control of the oxygen/carbon atomic ratio within the range from 0.216 to 0.38.

In addition, in the invention recited in Claim 7, since the upgraded biomass is a solid component (dewatered and, if necessary, dried solid component), the high heating value per dried weight unit can be obtained. In contrast, the upgraded biomass of Catallo is the light liquid upgraded biomass (volatile and semivolatile hydrocarbon) whose yields are on the order of 60% or more. Therefore, the characteristic of the upgraded biomass recited in Claim 7 is apparently different from Catallo.

Therefore, since there is no mention or suggestion of the object, technical features and the advantageous effects of claim 7 of the present invention in Catallo, Claim 7 has an inventive step over Catallo and should be allowed.

Claims 19 and 20 are rejected as being unpatentable over the combination of Catallo in view of White, U.S. 3,689,881. White is cited for the feature of gasifying the reaction products.

Claim 19 depends from claim 6, which in turn depends from claim 1, and claim 20 depends from claim 19.

Basically, the invention recited in Claim 19, which has been amended to independent form, is the method of producing an upgraded biomass gas in the presence of a gasifying agent by subjecting the upgraded biomass obtained by the invention recited in Claim 1.

Totally unlike this, White discloses a method of gasifying to produce synthesis gas comprising hydrogen and carbon monoxide from sewage (Column 2, lines 7-55).

The Examiner makes the combination of the gasification method disclosed in White with the reaction products of Catallo. However, as described above, since the method of upgrading a biomass of the present invention as set forth in main claim 1 is different from the method Catallo, the feature recited in Claim 19, which further includes a gasification treatment, sets forth a further difference from the combination of Catallo and White. Therefore, Claim 19 is clearly patentable over the combination of the references and should be allowed.

Claim 20 has been cancelled.

It is submitted that all of the active claims are clearly patentable over the cited art. Therefore, the application should be in condition for allowance.

Prompt and favorable action is requested.

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Respectfully submitted,

By _____
S. Peter Ludwig
Registration No.: 25,351
DARBY & DARBY P.C.
P.O. Box 770
Church Street Station
New York, New York 10008-0770
(212) 527-7700
(212) 527-7701 (Fax)
Attorneys/Agents For Applicant